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Investigate and Improving Routing Mobility Based On Random Way Point Mobility Model Using FTP Traffic in MANET

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Abstract- A Mobile ad hoc network (MANET) is a set of wireless mobile nodes forming a dynamic autonomous network.MANET is that which allows the mobile nodes to communicate with each other via a wireless medium without any infrastructure i.e. forms a temporary network. The main classes of MANET routing protocols are Proactive, Reactive and Hybrid. In this paper we compare performance of Proactive routing protocol by focusing on Optimized Link State Routing (OLSR) and Reactive Routing Protocol by focusing on Ad Hoc On Demand Distance Vector (AODV) and Hybrid Routing Protocols by focusing on Gathering Based Routing Protocols. In MANET, there are basically two types of Mobility Models. One is Traces and another one is synthetic models. Traces are those mobility patterns that are observed in real life systems. Which provide accurate information, especially when they involve a large number of participants and an appropriately long observation period? Synthetic models attempt to realistically represent the behaviours of Mobile nodes without the use of traces. In this work few synthetic models are considered. Here, we intend to study the "Random Way Point Mobility Model" and "Vector Mobility Model" and their impact on the performance of a MANET Routing Protocols: We analysis of the behaviour of mobile ad hoc networks when group mobility is involved.

Keywords— MANET, AODV, OLSR, GRP, OPNET, Routing Protocols.

1. INTRODUCTION

Mobile ad-hoc network (MANET) [1] is a collection of wireless nodes that dynamically create a wireless network among them without any infrastructure or centralized administration. Since no fixed infrastructure or centralized administration is available, these networks are self-organized and end-to-end communication may require routing information via several intermediate nodes. Nodes can connect each other randomly and forming arbitrary topologies. Each node in MANET acts both as a host and as a router to forward messages for other nodes that are not within the same radio range. The primary challenge in building a Mobile Ad hoc Network is equipping each device to continuously maintain the information required to route traffic.

MANET [2] research field has growing fast in few recent years. It was basically designed to make the user free from any pre deployed infrastructure. MANET is that which allows the mobile nodes to communicate with each other via a wireless medium without any infrastructure i.e. forms a temporary network. There is no need of access points, each node act as a router and node at the same time. These mobile nodes (router) can leave and join the network according to their own wish. MANETs [3] have a wide range of applications such as collaborative, distributed mobile computing (e.g., sensors, conferences), disaster relief (e.g., flood, earthquake), war front activities and communication between automobiles on highways. Most of these applications demand multicast or group communication.

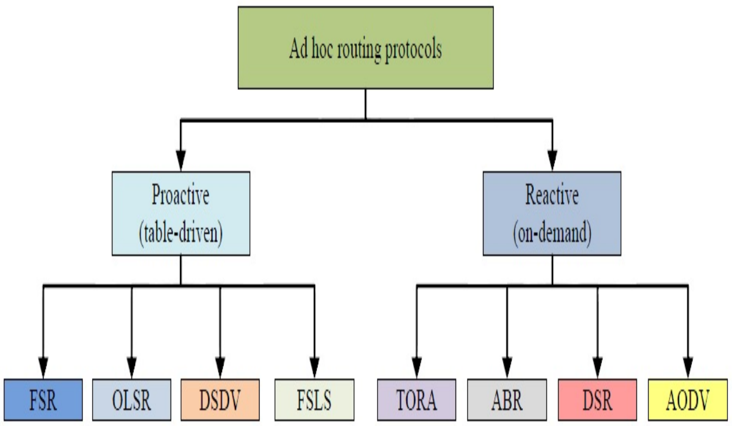

Figure 1: Classification of MANET Routing Protocols

The up to date standardized protocols are classified into three categories: Proactive routing protocols, Reactive routing protocols, Hybrid routing protocols. Proactive protocols, such as Optimized Link State Routing (OLSR) [4] [5] attempt to monitor the topology of the network in order to have route information between any source and destination available at all time. Proactive Routing Protocols are also called table driven routing protocols as all the routing information is usually kept in tables. Reactive routing protocols such as Ad hoc On Demand Distance Vector (AODV) [6][7], find the route only when there is data to be transmitted and as a result, generate low control traffic and routing overhead. Hybrid protocols such as Gathering-based routing protocol (GRP) [8] could be derived from the two previous ones, containing the advantages of both the protocols, using some quality of one type and enhancing it with the participation of the other one. In this paper we evaluate the performance of a Proactive Routing Protocol (OLSR), a Reactive routing protocol (AODV) and a Hybrid protocol (GRP). This paper is organized as follows: Section 2 presents overview of Routing protocols in MANETs. Section 3 describes the mobility models. Section 4 describes the performance metrics. Section 5 analyzes Literature survey. Section 6 concludes this paper.

2. Routing Protocols in MANETs

Routing protocols in MANET [9] [10] are divided into three categories: proactive, reactive and hybrid routing protocols. The most popular ones are AODV, DSR (reactive), OLSR (proactive) and GRP (hybrid).

This section describes the main features of three protocols AODV (Ad Hoc On-Demand Distance Vector Protocol), OLSR (Optimized Link State Routing) and GRP (Gathering-based Routing Protocol) deeply studied using OPNET 14.5. An ad-hoc routing protocol is a convention, or standard, that it improves the scalability of wireless networks compared to infrastructure based wireless networks because of its decentralized nature. Ad-hoc networks are best suited due to minimal configuration and quick operation.

2.1 Ad Hoc On-Demand Distance Vector Protocol (AODV)

AODV [11] is a reactive routing protocol that determines routes solely on-demand. It is based on the distance vector technology. The hosts only know the next hop to every destination. When a source host wants to send packets to the destination and cannot get the routes from its routing table, it will broad-cast a Route Request (RREQ)[2]. The receivers may establish the routes back to the source host through the paths that they get the RREQ. If the receiver has an active route to the destination, it will unicast a Route Reply (RREP) back to the source. Otherwise, the RREQ will be re-broadcast further. If a reply is sent, all hosts along that path may record the route to the destination through this packet. Because there may exist multiple exclusive paths between two hosts, a mobile host can receive the same RREQ more than once. To prevent the same request from being broadcast repeatedly, every re-quest is uniquely identified by a <Host ID, Broadcast ID>couple. Every host keeps a record for the RREQs that have been processed. The mobile hosts send out the Route Error (RERR) packets to their neighbors to report broken paths and activate the route rediscovery procedure.

AODV's desirable features are its low byte overhead in relatively static networks and loop free routing using the destination sequence numbers. There are improvements in AODV to support multicast, and to detect/maintain multiple paths. But the on-demand route query usually brings longer delay for the first few packets. It suffers from the problems of route request flooding and the use of MAC level broadcast. The genuineness of the destination sequence and distance vector leaves it vulnerable to attackers.

2.2 Optimized Link State Routing (OLSR)

Optimized Link State Routing (OLSR) [12] is a proactive, link state routing protocol specially designed for ad hoc networks. OLSR maintains Multipoint Relays (MPRs), which minimizes the control flooding by only declaring the links of neighbors within its MPRs instead of all links. The multicast nature of OLSR route discovery procedure can be integrated with the mobile IP management by embedding the mobile-IP agent advertisement into the OLSR MPR-flooding. This is important for the 4G global ubiquitous networks, which requires the wireless access network to be fully adhoc. Several extensions of OLSR are available that correspond to different network scenario. For fast changing MANET, provides a fast-OLSR version which reacts faster to topology changes than standard OLSR by enabling the fast moving nodes to quickly discover its neighbors and select a subset of their MPRs to establish connection to other nodes. Another routing protocol commented by IETF, Topology Dissemination Based on Reverse-Path Forwarding (TBRPF) [13], is very similar to OLSR. TBRPF achieves path optimization and uses an estimation algorithm to selectively broadcast the neighbor information, which leads to lower bandwidth overhead.

This MPR selector is obtained from HELLO packets sending between in neighbor nodes. These routes are built before any source node intends to send a message to a specified destination In order to exchange the topological information; the Topology Control (TC) message is broadcasted throughout the network. Each node maintains the routing table in which routes for all available destination nodes are kept. Control traffic in OLSR is exchanged through two different types of messages: "HELLO" and "TC" messages. HELLO messages are exchanged periodically among neighbor nodes, in order to detect links to neighbors, to detect the identity of neighbors and to signal MPR selection. TC messages are periodically flooded to the entire network, in order to signal link-state information to all nodes. The best working environment for OLSR protocol is a dense network, where the most communication is concentrated between a large numbers of nodes.

2.3 Gathering-based Routing Protocol (GRP)

Gathering-based Routing Protocol [14] is hybrid routing protocols that have the advantage of both proactive and reactive routing protocols to balance the delay and control overhead (in terms of control packages). Hybrid routing protocols try to maximize the benefit of proactive routing and reactive routing by utilizing proactive routing in small networks (in order to reduce delay), and reactive routing in large-scale networks (in order to reduce control overhead). PRP are suitable for supporting the delay sensitive data such as voice and video but it consumes a great portion of the network capacity. While RRP is not suitable for real-time communication, the advantage of this approach is it can dramatically reduce routing overhead when a network is relatively static and the active traffic is light. However, the source node has to wait until a route to the destination can be discovered, increasing the response time. The function of Gathering-based Routing Protocol (GRP) for mobile ad hoc network is to gather network information rapidly at a source node without spending a large amount of overheads. It offers an efficient framework that can simultaneously draw on the strengths of Proactive routing protocol (PRP) and reactive routing protocol (RRP) collects network information at a source node at an expense of a small amount of control overheads. The source node can equip promising routes on the basis of the collected information, thereby continuously transmitting data packets even if the current route is disconnected, its results in achieving fast (packet) transfer delay without unduly compromising on (control) overhead performance.

3. Mobility Models

In MANETs, mobile nodes roam around the network area. It is hard to model the actual node mobility in a way that captures real life user mobility patterns. Mobility models [15] are designed to evaluate the performance of ad-hoc networks and characterize the movements of real mobile node in which variation in speed and direction must occur during regular time interval. Therefore, many researchers attempted to design approximate mobility models to resemble real node movements in MANETs such as follows:

3.1 Random way point mobility model: - In this model, the position of each MN is randomly chosen within a fixed area and then moves to the selected position in linear form with random speed. This movement has to stop with a certain period called pause time before starting the next movement. The pause time is determined by model initialization and its speed is uniformly distributed between [MinSpeed, MaxSpeed].

3.2 Random walk mobility model :- In this mobility model mobile host moves from current location to new location by choosing randomly direction and speed from the predefined ranges between min speed and max speed.

3.3 Vector mobility model:-This model is used to avoid the unrealistic behaviour which is physically impossible. By remembering mobility state of a node and allowing only partial changes in the current mobility state, natural motions can be reproduced. Advantages of this model are: simplification of position updates, ease of implementation and opportunity for mobility prediction.

4. Related Work

1) In Bai, Fan, et.al[17], (2006) “A Survey of Mobility Models in Wireless Adhoc Networks.”(Chapter 1 in Wireless Ad-Hoc Networks. Kluwer Academic. 2006); it is discussed that mobility model plays a very important role in determining the protocol performance in. Beside the commonly used Random Waypoint model and its variants, we also discuss various models that exhibit the characteristics of temporal dependency, spatial dependency and geographic constraint V(maximum allowable velocity) and T(pause time)are the two key parameters that determine the mobility behaviour of nodes for every mobile node.
2) S. R. Biradaret.al[18] in their paper “Performance Comparison of Reactive Routing Protocols of MANETs using Group Mobility Model” (2009) they compare the performance of two on-demand routing protocols for mobile ad hoc networks Dynamic Source Routing (DSR) and Ad Hoc On-Demand Distance Vector Routing (AODV). They demonstrate that even though DSR and AODV both are on-demand protocol, the differences in the protocol mechanics can lead to significant performance differentials. The performance differentials are analyzed using varying mobility.
3) Liu Tie-yuanet.al[19] in their study “ Analyzing the Impact of Entity Mobility Models on the Performance of Routing Protocols in the MANET ”(2009) Present A comparative study on entity mobility models. Firstly, both the advantages and disadvantages of four typical entity mobility models are summarized; these models include the Random Walk model (RW), the Random Way Point model (RWP), the Random Direction model (RD)and the Markov Random Path model (MRP). Secondly, focus on primary parameters of these models, effects of both the speed and the pause time on the performance metric of MANET routing protocols are analyzed. Finally, with the help of the NS-2 simulator, the effect of different entity mobility models on the performance of MANET routing protocols is analyzed.

5. Simulation Environment And Performance Metrics

A metric is a standard measurement used in a routing algorithm to determine the best possible, effective and efficient route to a destination. The performance metrics used to measure the performance of routing protocols are; packet delivery ratio, throughput, end to end delay, network load.

5.1 Throughput: Throughput is defined as; the ratio of the total data reaches a receiver from the sender. The time it takes by the receiver to receive the last message is called as throughput. Throughput is expressed as bytes or bits per sec (byte/sec or bit/sec). A high throughput is absolute choice in every network.

Throughput can be represented mathematically as in equation (1);

$$\text{Throughput} = \frac{\text{Number of delivered packet} * \text{Packet size} * 8}{\text{Total duration of simulation}} \quad (1)$$

5.2 Delay*:* The packet End-to-End delay is the time of generation of a packet by the source up to the destination reception. So this is the time that a packet takes to go across the network. This time is expressed in sec. Hence all the delays in the network are called packet end-to-end delay, like buffer queues and transmission time.

Mathematically it can be shown as equation (2).

dend-end =N[dtrans + dprop + dproc]

(2)

Where

dend-end= End to end delay

dtrans = Transmission delay

dprop = Propagating delay

dproc = Processing delay

5.3 Network Load: Network load represents the total load in bit/sec submitted to wireless LAN layers by all higher layers in all WLAN nodes of the network. When there is more traffic coming on the network, and it is difficult for the network to handle all this traffic so it is called the network load. The efficient network can easily cope with large traffic coming in, and to make a best network, many techniques have been introduced.

Table 1: Simulation Parameters

Parameter	Value
Simulator	Opnet 14.5
Area	2.5×2.5 Km
Wireless MAC	802.11
Number Of Nodes	50
Mobility Model	Random Waypoint Mobility
Data Rate	11 Mbps
Routing Protocols	AODV,OLSR And GRP
Simulation Time	1800 Seconds

6. Results Analisis

In this fig .show that throughput in OLSR is the higher than AODV and GRP. We have the minimum throughput Fig.2 it is shows that the network throughput of GRP and OLSR becomes low with the random mobility of the nodes in the network scenario.

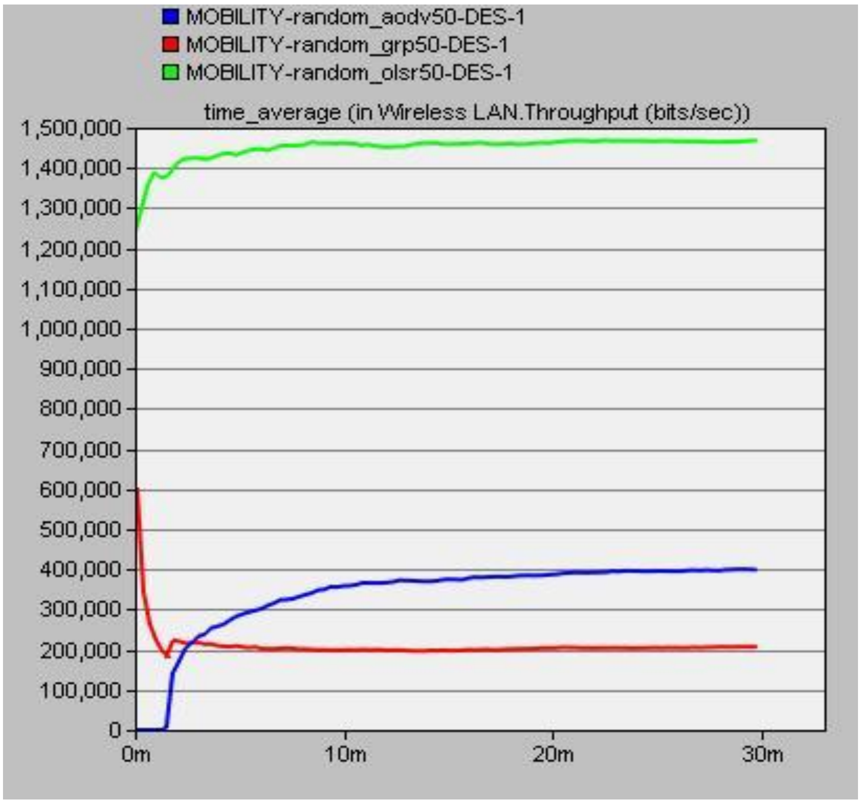

Figure 2: Throughput comparison in routing protocols with random mobility with 50 nodes

The average throughput for the network with 50 nodes is shown in Figure 2 which reflects the usage degree of the network resources for the typical routing protocols. It is the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network. With, the maximum throughput is approximately 1470000 bits per sec. Throughput increases quickly for OLSR with increased number of nodes. While AODV and GRP on the other hand has difficulties in finding routes when number increases, which clear from the figure.

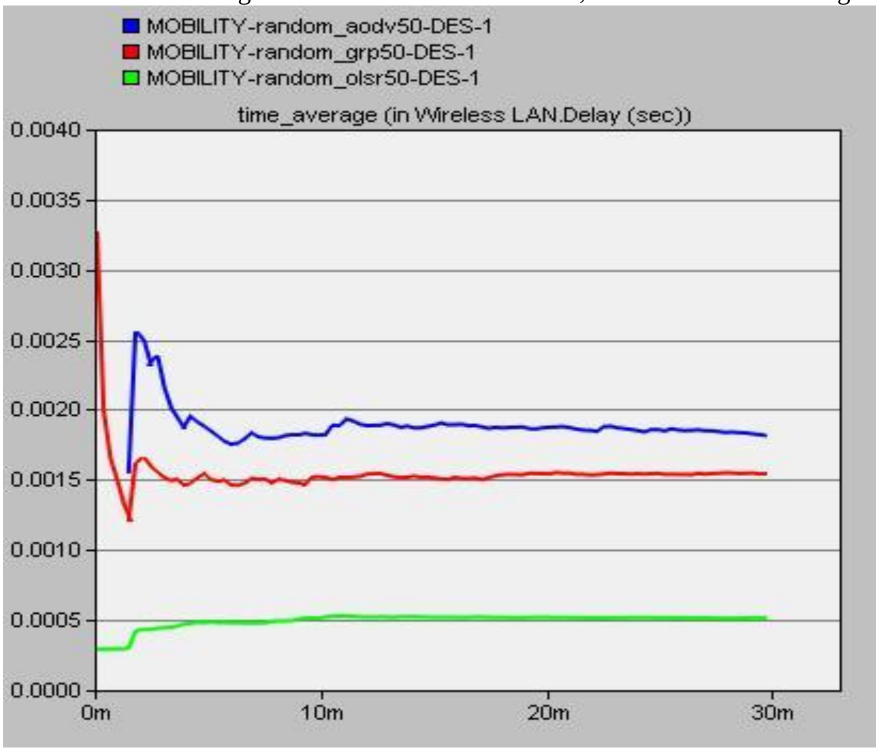

Figure 3: Delay comparison in routing protocols with random mobility with 50 nodes

In Fig. 3, we see that OLSR has initial delay at first of simulation. We can conclude that delay in OLSR is the higher than AODV, we have the minimum Delay. Figure 3 shows the performance of AODV, OLSR and GRP by evaluating End to End Delay with random waypoint mobility model with 50 numbers of sources(S) with FTP traffic.

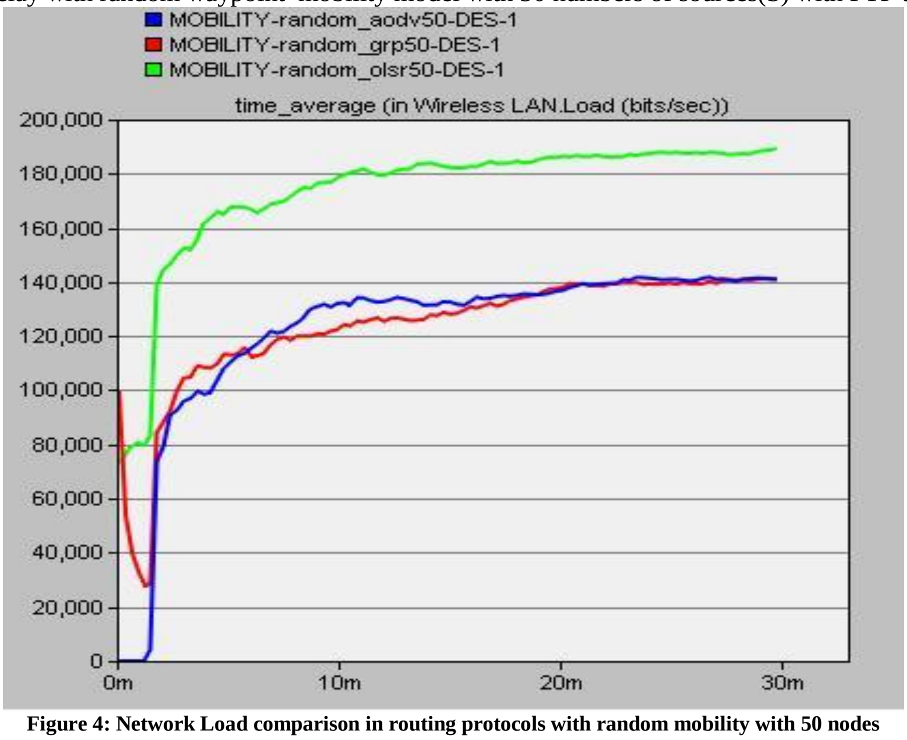

Figure 4: Network Load comparison in routing protocols with random mobility with 50 nodes

According to simulation, as we can see in Fig. 4, load in OLSR is higher than AODV and finally the minimum value of load belongs to AODV. In Fig. 4, we can see that under the OLSR, the value of network load start with peak value equal to 25,000 bit/sec and start to decrease for some duration of simulation period and after that start to increase along the simulation period to reach the peak value 200,000 bit/ sec.

7. CONCLUSIONS

Mobility imposes a stress to routing protocols due to link breakages and subsequent route discovery cost. Link failure is caused by invalid routes (from nodes that disappear from network) or stale routes (nodes with expired routes). When a link failure occurs, data packet messages also increase therefore increasing network traffic load. Additionally some routing protocols may not deal well with different traffic patterns. This adds a substantial burden which causes performance to degrade significantly during node mobility. Node mobility does play an important role in determining the performance of routing protocols .

In this paper, we discussed in the three routing protocols (AODV, OLSR and GRP), based on OPNET simulations. Our motive was to check the performance of these three routing protocols in MANET in the above mentioned parameters with mobility models. The selection of efficient and reliable protocol is a critical issue. The study of these routing protocols shows that the OLSR is better in MANET according to our survey and simulation results.

OLSR performed well in all network size and regardless of the increase in mobility. In addition OLSR has the lowest average delay. This is due to the fact that OLSR is a proactive protocol hence when a packet arrives at a node; it is immediately forwarded or dropped. Buffering enables OLSR to have a higher throughput than reactive protocols. Another obvious reason was that TCP traffic require route from both the source to destination and destination to source, which is demanding more from reactive protocols. Such routes are provided by OLSR.

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